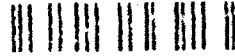


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Technical Report 13

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ENVIRONMENTAL CORROSIVITY AT OAKLEY ARMY AIR BASE, QLD.
AUGUST 1991 TO AUGUST 1992

by

P.W. HABERECHT
B.R.W. HINTON

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**ENVIRONMENTAL CORROSIVITY AT OAKEY ARMY AIR BASE, QLD.
AUGUST 1991 TO AUGUST 1992**

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**P.W. HABERECHT
B.R.W. HINTON**

SUMMARY

The BELL 206-B1 helicopters at Oakey Army Air Base are often placed in storage hangars, for periods of 90 days or more. The OEM recommends the aircraft should be stored in a special plastic protective bag and a dehumidifier attached to the protective bag. The use of this protection may not be warranted since the measured rate of corrosion in the storage facilities, using the CLIMAT or wire on bolt assessment method, indicates that the corrosion rate is 'negligible' for the assessed 12 month period. Additional to this evaluation, testing of Water Displacing Corrosion Preventatives (WDCP's) was carried out. The results clearly show that at the exposed Oakey sites, the WDCP's provided very good protection.



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1. INTRODUCTION

To prevent corrosion during the storage of Bell 206-B1 helicopters for periods greater than 90 days, the aircraft are enclosed in a Global Redicover Bag (Figure 1), which is connected to a dehumidifier (1). Although these one-piece bags with a special airtight maxigrip zipper are fabricated from a tough, abrasion resistant polyurethane film, they are susceptible to punctures, tears and failure (2)(3). They are not readily available at the Oakey Army Air Base, and their replacement cost is approximately \$20,000.

To confirm the need or otherwise, for their use, an assessment of the corrosion severity of the local environment at the Oakey Army Air Base was instigated at the request of both RAAF and Army.(4) The corrosivity of the atmospheric environment over twelve months was determined at the following locations:

- (1) a storage hangar,
- (2) an exposed area outside a storage area,
- (3) an exposed site in the vicinity of aircraft ground operations.

This report summarises the seasonal corrosivity patterns for the twelve months from August 1991 to August 1992. An evaluation of the efficiency of a number of different water displacing corrosion preventatives (WDCPs) was also carried out.

2. EXPERIMENTAL DETAIL

The technique used to determine atmospheric corrosivity employs a CLIMAT Specimen (CLassify Industrial and Marine Atmospheres) (5). This specimen consists of 90 cm of aluminium wire (0.875 mm diameter) wound tightly into the threads of a coarsely threaded bolt (12 mm diameter, 1.5 mm pitch).

The bolts are made from steel, copper or a non-metal such as nylon, teflon etc. When exposed to the environment, galvanic corrosion and crevice corrosion occur between the aluminium/copper (Al/Cu) or aluminium/steel (Al/Fe) bimetallic couples. Only crevice corrosion occurs on the Al/Nylon specimen. The advantages of the specimen design are:

- (1) the wire provides a large surface area for corrosion, which minimises errors in determining the corrosion rate, and
- (2) various rates of corrosion relating to the classification of a particular environment can be obtained by the choice of a suitable metal bolt.

The rate of corrosion is determined by calculating the weight-loss for the aluminium wire over a given exposure period, usually 90 days. A 'Corrosivity Index' for each bimetallic couple is then calculated as follows:

$$\text{CLIMAT Indices} = \frac{\% \text{ weight loss}}{\text{Days exposure}} \times 90$$

$$\% \text{ weight loss} = \frac{\text{weight loss} + \text{losses due to chemical cleaning}}{\text{initial weight}} \times 100$$

These indices are widely used to classify the severity of atmospheric environments. Extensive research (5-11) has shown that the Al/Cu specimen has a higher rate of corrosion than the Al/Fe specimen in industrial atmospheres, while in marine environments the Al/Fe specimen has a higher rate of corrosion than the Al/Cu specimen. Thus, the Al/Cu specimens are generally used to classify industrial atmospheres and the Al/Fe specimens to classify marine environments.

Duplicate Al/Cu, Al/Fe, Al/Nylon CLIMAT specimens were prepared and mounted on six racks. The specimens on one rack were coated with water-displacing corrosion preventative's (WDCPs) WD40, Boeshield T9, and Amlguard MIL-C-85054. WDCPs have been used successfully to temporarily prevent corrosion on aircraft structure, and ARL has commenced a program to determine their effectiveness in preventing corrosion on land-based structures. The current project provided an opportunity to extend this program.

The location of specimen racks, installed at the Oakey Base (12-15), are listed in Table 1. The rack containing specimens coated with the WDCPs was installed at the control tower.

In order to determine the corrosivity at the Base over a full year, a total of 4 set. of specimens were installed at 90 day intervals, commencing on the 22nd August 1991 and concluding on the 24th August 1992. The accumulated results provide an indication of seasonal climatic variations compared to the measured corrosivity of the environment.

2.1 Weather Monitoring

Monthly weather data for Rainfall (mm), Max Temp (°C) and Relative Humidity (%) at 9 am were obtained from the Bureau of Meteorology, Oakey Aero. Met. Office (16,17) for the period of January 1991 to September 1992, which includes the 12 month period of investigation.

3. RESULTS

3.1 Corrosion Indices - August 91 to August 92

Figures 2 and 3 compare the 'Corrosion Indices' obtained with Al/Cu or Al/Fe couples after exposure over the 12 month period. It should be noted that scatter in the CLIMAT results for the Al/Cu and Al/Fe couples (12-15) is ± 0.1 index points. This data indicates that over four successive seasons, the outside environment (ie Control tower) is more corrosive than the indoor environment (ie Long term storage hangar). The range of results for the outside specimens were index values of 0.5 to 2.10 (Al/Cu couple) and 0.3 to 2.60 (Al/Fe couple). Figures 4 and 5 show specimens after exposure on the control tower and in the long term storage hangar.

Based on these values, general environmental corrosivity of the Oakey Aviation Area, was found to be in a range of index values of 0.5 to 2.6 (Al/Fe couple) and 0.3 to 2.1 (Al/Cu couple). The CLIMAT assessment may thus be classified as negligible to moderate with a brief moderate to severe condition experienced in Autumn.

The range of index values for the indoor specimens were from 0.00 to 0.10 (Al/Fe couple) and 0.00 to 0.20 (Al/Cu couple). No significant corrosion had occurred in the enclosed areas over the past 12 months of evaluation. The long term and short term storage areas had the lowest recorded corrosivity of all of the indoor specimens and the range of results were index values of 0.00 to 0.01 (Al/Fe couple) and 0.00 to 0.01 (Al/Cu couple).

These results indicate that the environmental corrosivity within the storage facilities is "Negligible". Given the very low corrosivity of the storage area, it is difficult to see that the use of the Redicover bags and dehumidifier would provide enough extra corrosion protection to justify the expense associated with their purchase and use.

3.2 Water Displacing Corrosion Preventatives (WDCP's)

Compared with the unprotected specimens exposed on the control tower, very little corrosion was detected on any of those treated with WDCP's at the end of each of the four consecutive periods.

All of the WDCP's reduced the measured corrosion rate by around 90%. These results indicate that one application of any one of the WDCP's will effectively inhibit corrosion in this environment for a period of at least 3 months. Subject to Original Equipment Manufacturer (OEM's) approval, the recommended WDCP's could be considered as a temporary corrosion protection method for metallic components during storage.

Caution should be exercised in only using the OEM's recommended MILSPEC WDCP's, with special attention to type of WDCP's and to the areas of permitted application.

The three WDCP's used for the experiment were WD40 (Oily film), Boeshield (Waxy film), Amlguard (Hard film). After 90 days exposure, the oily and waxy film specimens were found to be lightly coated with dust particles adhering to the WDCP coating.

3.3 Local Climate and Environmental Corrosivity

In figure 6 environmental corrosivity ('CLIMAT index' from the Al/Fe couple) and the climatic variables are plotted for each month over the past year.

There is no obvious correlation between the averaged monthly climatic variables (figure 6) and the seasonal variations in environmental corrosivity. The higher rainfall during summer did not apparently increase the corrosivity of the environment.

The higher environmental corrosivity measured during Autumn could be related to other non-climatic factors such as: airborne contaminants, arising from the local use of fertilisers, used during the preparation for planting of the local grain crops or, the aerial spraying of herbicides and pesticides.

It is important to understand that if the stored components were to have been coated with salt or other contaminants, as a result of coastal operations, and were not washed prior to storage, then the rate of corrosion experienced by these components would be dramatically affected, independent of the general environment that exists within the storage facilities.

4. CONCLUSIONS

- (a) The corrosivity of the outdoor environment, during the season of Autumn, was significantly greater than for the other seasons.
- (b) On the basis of the 12 month test period, the environments in the long term storage hangar and the short term storage hangar are classified as having "Negligible" ⁽⁵⁾ corrosivity.
- (c) The dehumidification of the storage facilities⁽¹⁾ for the Bell 206B-B1 Helicopters, and the use of the Redicover bags, would not provide enough extra corrosion protection, given the low corrosivity index for the storage facility, to justify their use.
- (d) One application of any one of the WDCPs tested effectively inhibited corrosion for a 3 month period.

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Lat 27 25 S, Lng 151 44 E Elevation 406.4m
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Lat 27 25 S, Lng 151 44 E Elevation 406.4m

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Lt. S.Evans

Table 1:

Locations of CLIMAT specimens at Oakey Base

1	Long term storage hangar for Bell 206B Helicopters and Pilatus Porter Aircraft.
2	Aviation support workshop.
3	Short / Long term storage hangar for Blackhawk Helicopter and Pilatus Porter Aircraft.
4	Major daily storage and maintenance area for operational aircraft.
5	General operations e.g. start up and taxi-ing area for helicopters.
6	Control Tower (Northerly aspect).

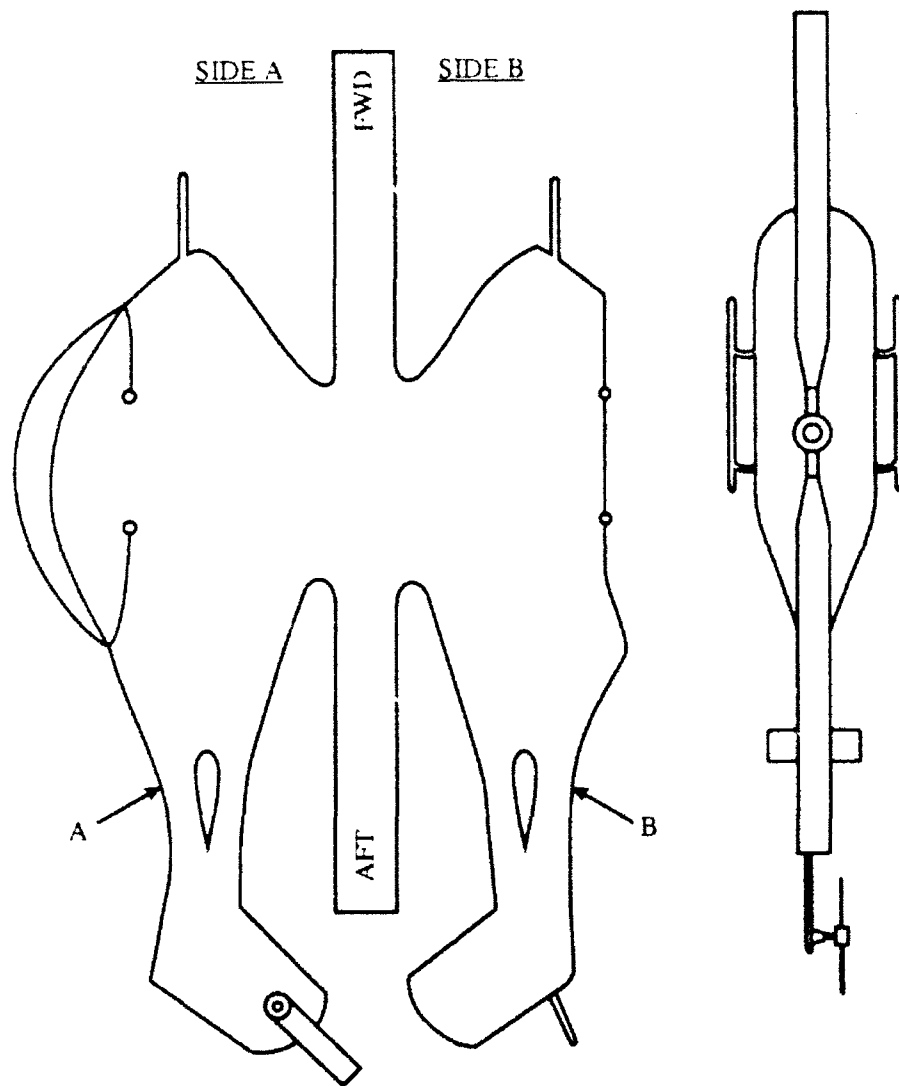


Figure 1: The Global Redicover Bag for Long term Storage of the Bell 206-B1 Helicopter

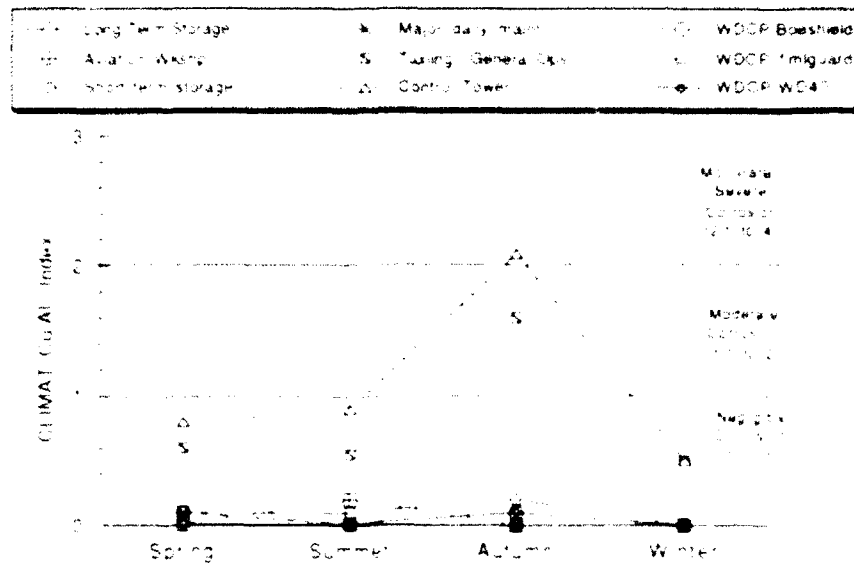


Figure 2: CLIMAT Corrosion indices obtained with the Al/Cu couple at various Base locations from Aug 91 to Aug 92.

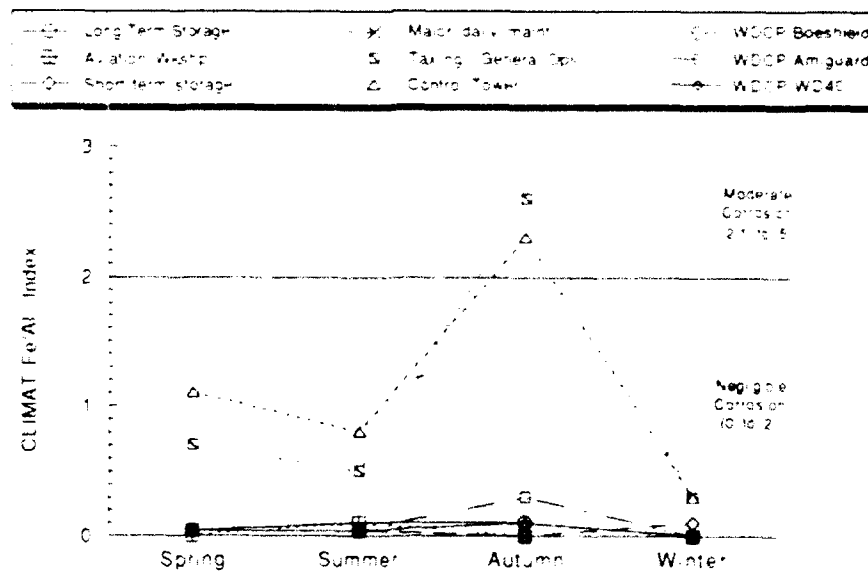
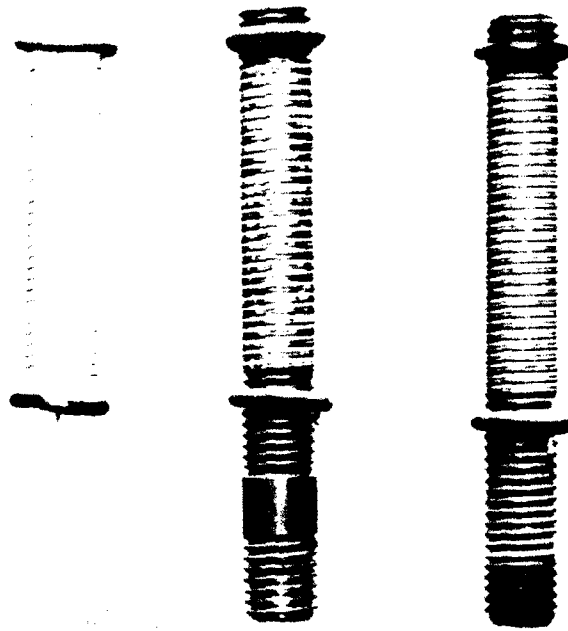
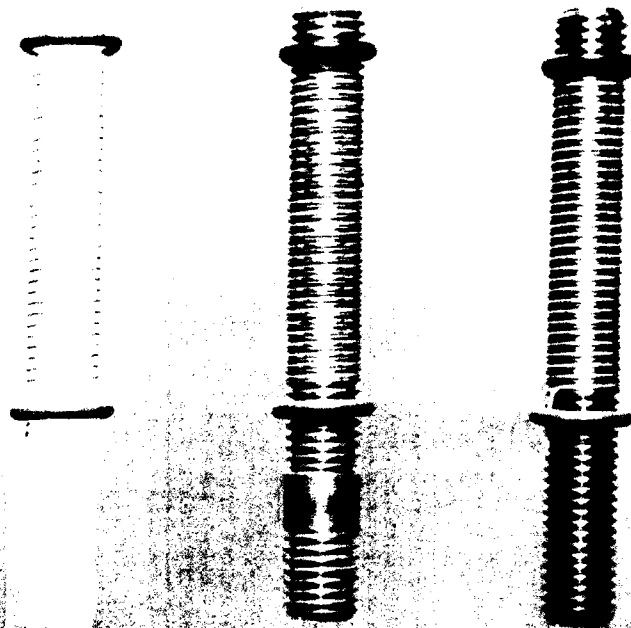


Figure 3: CLIMAT Corrosion indices obtained with the Al/Fe couple at various Base locations from Aug 91 to Aug 92.



June 92 Aug 92: Control Tower

Figure 4: CLIMAT Specimens after 90 days exposure on the control tower northern balcony at Oakey.



Long Term
Storage Hangar

Figure 5: CLIMAT Specimens after 90 days exposure in the long term storage hangar at Oakey.

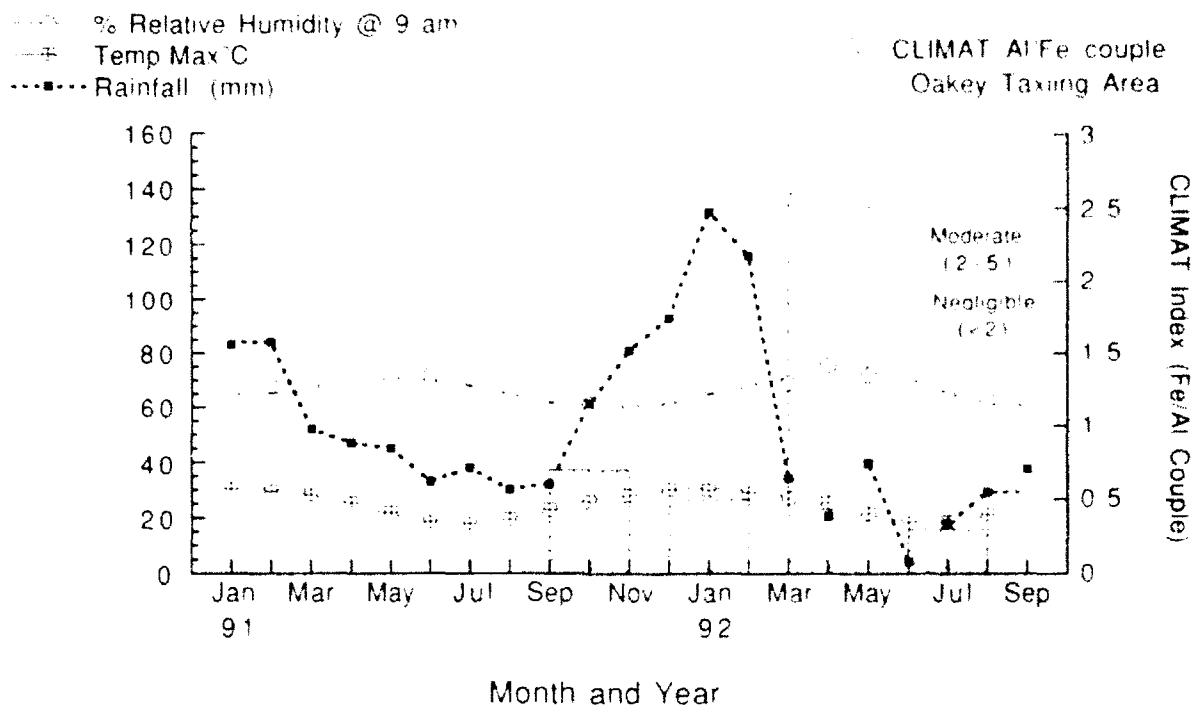


Figure 6: CLIMAT Corrosion indices obtained with the Al/Fe couple compared to measured climatic conditions for 12 months.

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